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A process has been described in which two individual desmids conjugate, each semicell of one with a corresponding semicell of another individual, the result being the formation of two zygospores from a single conjugation of only two desmids. In Cosmarium bioculatum only a single individual desmid was ever noticed to effect the formation of the spore. The latter was devoid of spines and resembled the ordinary zygospore reported for the individual.

Some attempts were made to obtain the subsequent stages of the development of resting spore in the laboratory and in the field. Though the material remained in the spore state for months it eventually disappeared and in the laboratory this was principally due to the ravages of minute water insects that could not be eliminated from the aquaria. In attempts to study field material no better results were obtained. Late in the summer the stream had dried up, not however, before all the desmid forms had disappeared. The following year, as already stated, practically no desmids were found and absolutely no Cosmarium bioculatum. Nothing but some ordinary forms of algae such as Vaucheria sessilis and Vaucheria dichotoma, (Lyngb.) Ag. some small forms of Spirogyra, Zygnema insigne, and vegetative Mougeotia scalaris.

A Biological Study of Noctiluca miliaris, Suriray.

A. M. KIRSCH.

Some months ago there was sent to the Zoological laboratory of the University of Notre Dame, a vial containing what proved to be Noctiluca, collected on the Oregon shore of the Pacific Ocean, and with the specimen a request was made what it might be. Noctiluca is a comparatively well known animal in zoological literature, and Dr. O. Bütschli in his work on the Protozoa, which forms the first volume of Bronn's "Klassen und Ordnungen" mentions no less than forty-one authors that speak either directly or indirectly of this highly interesting flagellate protozoan. Our experience above referred to illustrates that many workers in Zoology need more than the classical literature to identify the many curious animals they now and then meet with. It is not the primary purpose of the Midland Naturalist to publish exhaustive memoirs or treatises for specialists in Biology, but rather to give helpful knowledge to the middle class of naturalists scattered over our territory.

Without entering deeply into the historical part of the literature of Noctiluca, we may mention that in regard to the phosphorescence of sea-water so often noticed along the sea-coast it was very early found that Noctiluca was one of the causes of this phenomenon. J. Sparshall in 1742 investigated this phosphorscence, and Bütchli states that he has no doubt that the glimmering sea animalculae observed by Sparshall were really Noctiluca.

The Abbé Dicquemare in 1775 also observed and studied the phenomenon of phosphorescence on the coast at Havre, France, and by filtering the water proved that the phosphorescence was not due to the water, but to the small animals which he had gathered on the filter. The physician Suriray of Havre, however, left us in no doubt whatever that the animalculae were observed, and recognized by him. His illustrations and especially that of the striated structure of the tentacle of the animal, together with his accurate description have given him the right to name the animal Noctiluca miliaris, a name by which it is still known. In 1811 he had sent his treatise on the animal to the Academy at Paris but it was not published until 1836.

Suriray classified the Noctiluca among the polyps, and others had placed it in with the medusae. Doyère and P.van Beneden, however, regarded Noctiluca as a member of the sarcode animalculae of Dujardin. The latter himself placed it among the Foraminifera or the Rhizopoda, but Ernst Haeckel placed it among the Flagellata (Mastigophora), and created for it a special order called the Cystoflagellata. Into this order was also placed Leptodiscus of R. Hertwig, 1877, so that at present the Cystoflagellata contain only two genera, Noctiluca and Leptodiscus.

Noctiluca miliaris, Suriray, is at present the only commonly recognized species. Bush in 1851 had described a second species under the name of Noctiluca punctata, but this was considered as not different essentially from N. miliaris. Gigioli (1865-68) after his journey around the world described what he called Noctiluca homogenea, and Noctiluca Pacifica. Bütschli says concerning these supposed species: "Since there are no illustrations given and as the short descriptions do not inspire confidence, I regard them as doubtful species."

All authors so far seem to agree that Noctiluca miliaris is cosmopolitan and the genus monotypic, and therefore more

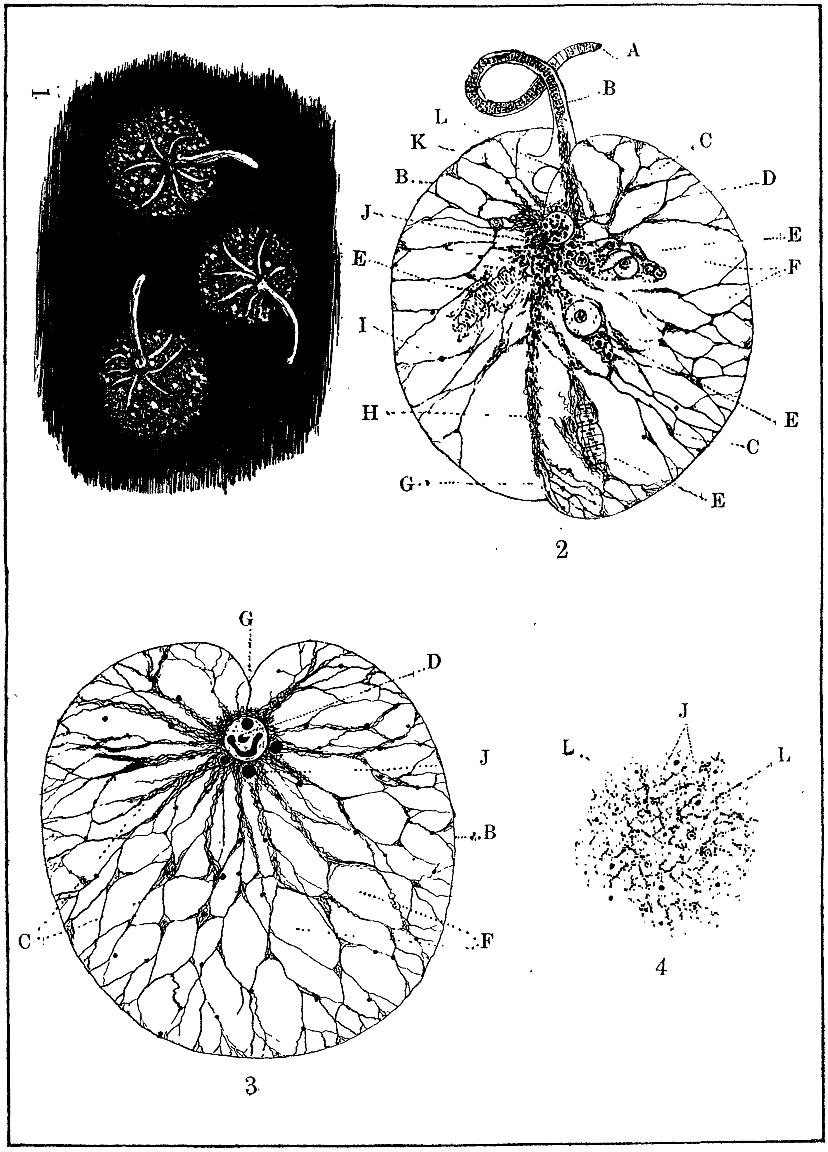

PLATE II.

Fig. 1. Noctiluca miliaris, Sur. as it appears phosphorescent in the dark.
Fig. 2. Oblique view of an individual with tentacle facing the observer.
A. Tentacle, B. Cell wall extending over the tentacle.
C. Reticular threads of the protoplasm.
D. Nucleus.

accurate study is required before deciding whether Noctiluca Pacifica can be regarded as a valid species.

The material at my disposal is not sufficiently well preserved to allow me to pronounce an opinion about the specific character of the Pacific Ocean animal, and moreover it is only by the study of the living specimen of such a delicate animal that one could be justified in giving a scientific opinion. The present paper was prepared partly for the benefit of those on the Pacific coast who are in a position of obtaining fresh material for study. Some fundamental data as to the structure of Noctiluca miliaris will be given and I leave it to others to decide whether Noctiluca Pacifica be a well grounded species.

At one time Noctiluca had been placed among the Medusae, but a closer examination of the structure of the animal reveals to the microscopist the fact of relationship to the phylum of the unicellular Protozoa, and that it belongs to the class of the Flagellata. Owing to its bladder-like appearance we would refer it at once to the Cystoflagellata as its proper order. Its name seems appropriate, meaning "night light," evidently referring to the property of producing diffused phosphorescence of sea water in the dark. This light is apparently produced by the layer of protoplasm, situated immediately under the cuticle, and is caused by some process of oxidation. The light is by some said to be caused

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E. Algae and diatom carapaces; (Food inclusions) in the protoplasm.
G. Buccal groove. F. Vacuoles containing water.
H. Bundle of reticulum continuing the groove, and forming the rod.
I. Fat globules stained black with osmic acid.
J. Central protoplasm containing numerous fat globules I, and nucleus, D.
K. Mouth.
L. Bundle of reticular threads connecting the central protoplasm with the tentacle where they become transversely striated.

Fig. 3. Optical section of Noctiluca perpendicular to the groove, G. and passing through the central protoplasmic mass. D. Nucleus. J. Central protoplasm, B. Cell wall. F. Water vacuoles. C. protoplasmic threads.

Fig. 4. A small portion of protoplasm showing its structure as it appears just under the cell wall.
J. Trabeculae of the reticulum.
L. Enchylema filling the spaces between the threads of the reticulum, and containing the fat bodies, (Inclavata.) [Partly after Carnoy.]

by the oil globules abundantly found in the meshes of the protoplasmic reticulum.

As to the form of the animal it is more or less globose, and had it not been called Noctiluca—"night light"—on account of its phosphorescence, one might, on account of its shape, have been tempted to name it "Sea-peach," owing to its remarkable resemblance to a peach, or apricot. Hertwig states that, in size, the animal may be one millimetre in diameter, but the largest that the author ever found, after examining thousands, was no greater than than 640 micra in diameter.

The movement characteristic of the animals may be described as a rolling, swinging motion. They remain quite near to the surface of the sea, and in such numbers that they cover the upper layers of the water like a mass of jelly, at such times exhibiting at their best the wonderful phosphorescence of the sea.

Considering the fact that Noctiluca belongs to the unicellular animals, and that its structure is simple, it is still very striking. The animal is covered with a cuticle or cell-wall which we find to be about 1 to 2 μ. in thickness. The author could make out no definite structure to this membrane, though from the observations of Cienkowski one would infer that some structure exists. Cienkowski regards the cuticle as a more firm part of the interior, to use his words, "*eine viel festere Consistenz als der Inhalt.*" In fact, Bütschli considers this cuticle identical with von Mohl's "primordial utricle," or with the "structured cell-wall" of Carnoy, in contradistinction to an amorphous secretion serving as a special protective membrane or covering. Bütschli, however, doubts whether this holds good for the cuticle that covers the tentacle.

As appears in our illustration, this cuticle shows with marked distinctness around the tentacle, and we would be inclined to think that at least here the cuticle is chemically and physically different from that which covers the rest of the animal.

A noticeable external structure of the animal is the groove which extends about one fourth around the periphery, and may be termed the peristome groove, and is continued by an elevation for some distance. (Fig. 2, H.)

The tentacle already mentioned is the most noticeable external structure, and it arises from the border of the peristome groove. This tentacle is very characteristic, and has given rise to considerable comment as to its origin, though no one has, in our opinion, given a satisfactory explanation as to its homology. In fig, 2, we notice the striated appearance of this organ, the striations being, however, confined to the protoplasmic interior. A bundle of fibres starting from the central mass of protoplasm around the nucleus is very evident, and these become abruptly striated in the tentacle. Special emphasis should be laid on this fact, as it is a direct proof of Prof. Carnoy's view concerning the physiological role that the reticulum of the protoplasm performs in the life functions. According to him, "the reticulum of the protoplasm is the sole seat of irritability and contractility, and it alone determines the physical movements of living things."* We see in this tentacle with its striated structure a transformation of reticulum into a muscle fibrilla.

From a phylogenetic point of view we might call attention to the similarity of the structure of the tentacle of Noctiluca to the stalk of a Vorticella. Such questions as the following might be asked: "Might not the ancestral forms of Notciluca have been fixed by a stalk like Vorticella? Is Noctiluca a freed Vorticella with the stalk persisting as a tentacle and still exhibiting the same structure? In other words, has Noctiluca the same ancestral forms as Vorticella?" These are questions that intrude themselves on our mind while we study the structure of Noctiluca and particularly of its tentacle. In Vorticella the stalk is the organ of motion, the cilia being used only to convey the food to its mouth. As long as the stalk is fixed at its distal end, the motion of the animal is limited, and it is necessary that it have organs to bring food to the mouth. In Noctiluca the stalk being freed from its permanent attachment it becomes an organ of free motion. The crown of circumoral cilia, therefore, becomes useless, degenerates, only a single cilium remaining to trace the ancestral relationship. Close to the mouth of the animal and between it and the tentacle, is noticed a zigzag line which Huxley called the tooth, and near it a small lobule called the lip from which arises the solitary remaining cilium which is seldom seen in preserved material. Near this is the slit-like opening, the mouth, leading into the interior of the central protoplasm. All the structures just mentioned are situated in the buccal groove. From the end of the buccal groove a string of fibrillar protoplasm extends for some distance farther and produces a raised ridge (Fig. 2, H). This is the rod, the function of which is not known.

After thus completing the study of the external anatomy of Noctiluca, we may penetrate into the labyrinth of its internal structure. Immediately under the cuticle we see as represented in fig. 4, the fine structure of typical protoplasm. We notice first the trabeculae of the delicate network or reticulum, and the enchylema filling the spaces between the network. At intervals we notice globules of fat which stain black with osmic acid. Deeper into the interior of the animal as in fig. 3, we notice the nucleus surrounded by the central mass of protoplasm, situated immediately under the buccal groove. In the live animal the fat globules move along the shreads of reticulum, which movement is evidently caused by the contractions of the reticular meshes themselves. These meshes are continually rearranging themselves. Some disappear and new ones again reform so that the pattern seen in fig. 3 may change in a short time into an entirely different one. The meshes of this network are evidently formed by the banding together of the plasmatic reticulum caused by the absorption of water which fills the large spaces called water vacuoles.

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* Carnoy.—Biologie Cellulaire page 196.

From figure 2 of the plate we obtain a synthetic view of the whole animal, and a hetter impression of the relationship of the parts. We find certain bodies engulfed in the protoplasmic mass and we call these inclusions, as they are evidently things not belonging to the structure of the animal nor formed by the animal. The shape and markings of these foreign bodies show them to be cells of algae and carapaces of diatoms. They are the food of the animal and were introduced at its mouth and are lodged in the food vacuoles.

In the central mass of the protoplasm is noticed the nucleus a body necessary to every cell. Though much could be said about this nucleus, its structure, its transformations incident to cell division, its essential necessity in the porcess of generation, and its chemical composition, we can not enter upon these questions here.

After this brief morphological examination of Noctiluca, we might make a few notes on its physiological functions and chemical composition. Living material is of course needed for physiological study. The first thing that strikes us here is the wonderful activity of the animal's movements. We notice first the power of locomotion and that the tentacle is the organ of this motion. Beside this there is the wonderful life-activity displayed in the interior of the animal, the contractions of the meshes in the network already referred to, their disappearances, reformations and changes, as also the flowing of the fine granules of the enchylema along the strands of the reticulum, accompanied with the streaming about of the fat globules. We recognize in this movement the tendency to supply the distant parts of the animal with food. In other words this is a crude mode of circulation analogous to that of the higher animals. The minute granules of the enchylema may be analogous to the blood corpuscles. Wherever we observe in living things this streaming movement of the protoplasm, the granules seem to be the food carriers. The location of the food vacuoles in the interior of protoplasm corresponds to a primitive digestive system. From these interior food masses, the meshes radiate in all directions and from them likewise the streaming of the protoplasm proceeds. Careful observation will reveal the method of the ingestion of the food and its rapid digestion in the food vacuoles, (extemporized stomachs) as also the egestion of the undigested particles by the same opening through which ingestion took place. Thus in the unicellular animals we have all the physiological functions exhibited in their simplest ways. We realize here the meaning of the expression of Carnoy: "It is therefore to the cell, that abyss of littleness, that we must descend to seize life in its material source and wrest from it some of its secrets." Dr. Winfield S. Hall, professor of Physiology of Northwestern College of Medicine, also aptly gave utterance to this truth: "No one can do real and serious work in human physiology, who has not mastered Cytology.',

Noctiluca possesses no differentiated nervous system but as it shows irritability as produced by the nervous system of the higher animals we refer this characteristic to its undifferentiated protoplasm.

The process of reproduction is the last physiological function to which we may call attention in Noctiluca. The mode of reprduction is by cell division and by budding, in each the nucleus takes the prominent part in the process. We can not go further into detail in describing the methods, but for information we must refer the reader to the classical works among which we might quote Bronn's "Classen und Ordnungen."

To study the bio-chemistry of Noctiluca we might apply the various reagents and stains to determine the nature of the structures of the animal. Thus, osmic acid, as we saw, stains the fat globules ebony black. Methyl green, which Carnoy calls the "touchstone" of nuclein will reveal the fragmental pieces of the nucleus to be composed of the nuclein of Meyen. There are other reagents that will show the reticulum to be composed of plastin and the cuticle of elastin. From a large number of Noctiluca, collected in bulk, we could extract several soluble frements such as diastase and pepsin. Though we have not given as complete a study of this wonderful phosphorescent animal as we might have desired, still we hope that we have said enough about its ordinary characteristics to show that it deserves more than usual attention in courses of cytology.

Notes on the Priority of Certain Plant Names.

J. A. NIEUWLAND.

Having had occasion to examine some volumes of early botany by authors whose several works came out shortly after the publication of the Species Plantarum of Linnaeus, 1st Ed. 1753, I found that there are a number of genera restored earlier than the dates usually quoted in some of our common texts. As the older botanists made it a rule to restore the earlier names that Linnaeus suppressed rather than create new ones, they are nearly always unanimous in the choice of the names applied to any particular restored genus. Hitherto most of the following restorations have been credited to Adanson, 1763,* but I find that these authors have anticipated him in many cases. I shall quote only the title of the book, the writer's name, and the date of publication of the volumes referred to.

DUHAMEL DU MONCEAU. Traite des Arbres et Arbustes, 1755. Also the German edition of the above: 1762, 1763.

HILL, J. British Herbal, 1756.

SHAW, T. Travels and Observations Relating to Several Parts of the Levant. (In the end of the book.) Collectanea, Specimen Phytographiae Africanae, 2nd Ed. 1757.

LUDWIG, C. G. Definitiones Plantarum, 3rd Ed. (by Boehmer,) 1760.

MORANDI, J. B. Historia Plantarum Practica, 2nd Ed. 1761.

The following are some of the genera and species restored. I shall give the dates when available and indicate at the end of each item the hitherto accepted names, authors, and dates.

1. Persicaria, Hill, 1756, instead of Persicaria, Adanson, 1763.
   Also Persicaria, Shaw, 1757.
   Persicaria, Morandi, 1761.

Thus the publication of Adanson was preceded also by that of both Shaw and Morandi. The genus has been recognized as separate from the Linnaean aggregate Polygonum. Bistorta, another of the Polygonum segregates was also restored by Morandi

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* Adanson, M. Familles des Plantes, 1763.